

Outbreak Investigation in Healthcare Settings

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Outline

- **Review steps**
- **Common problems and scenarios**

STEPS TO AN INVESTIGATION IN A HEALTHCARE SETTING

Take a Systematic Approach to Investigation

- **Confirm the outbreak/establish background rate**
- **Confirm the diagnosis**
- **Define a case**
- **Case finding**
- **Line list**
- **Determine who is at risk**
 - Observations
 - Interviews
 - Case review
- **Develop a hypothesis**
- **Test hypothesis**
- **Follow-up/Communicate results**

Key Point

- Outbreaks can be chaotic
- Might not proceed step by step
- Important that you consider each step
- Multiple steps may happen at once
- Might repeat steps

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Is It an Outbreak?

- For epidemiologists:
 - An increase in the incidence of a disease above what is normally expected
 - What is the background rate?
- Is it important?
 - One case can be an outbreak and may require investigation:
 - One case of healthcare associated *Legionella*
 - First case of an important MDRO
 - May have lots of cases and may not be important
- Outbreak vs. cluster - basically the same

Pseudo-outbreaks

- Increase related to something other than an increase in true disease
 - New definitions
 - New tests
 - Change in culturing practices
 - Laboratory contamination
 - Misdiagnosis
- May still be important

M. abscessus

- 143 cultures positive in 2005-2006
- Indistinguishable by PFGE, took a long time to grow
- Clinical cultures from incubator grew *M. abscessus*
- Uninoculated control tubes also grew

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How to Identify Outbreaks

- Surveillance systems
- Providers (“the astute clinician”)
- Reports from public health
- Laboratory reports

Not all Outbreaks Need a Large Investigation

- Sometimes common problems occur that are related to common breaches
- In these instances implementing well known interventions might control/resolve the problem
- Be cautious of the urge to continually “throw” interventions at a problem you don’t understand

Literature Review

- Is an important place to start.
- There are LOTS of published outbreak investigations- 71,688 as of March 2010!
- You will get good leads both on where and how to start your investigation.
 - What associations have been found before
 - Niches for organisms

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Case Definition

- Description of what you are looking for
- Narrow enough to focus efforts but broad enough to catch all the cases
- Orient with respect to person, place and time
 - An MRSA SSI developing in a person after undergoing cardiac surgery at hospital A between January 1 and December 31
- May change as time goes on
- Don't get bogged down -- Goal is not to capture all cases!

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How do You Find Cases?

- Microbiology data
- Infection control or surveillance records
- Discussions with clinicians
- Pharmacy records
- Medical records
- Pathology reports

Case Finding Issues

- Remember goal is to stop the outbreak – do not need to find every case
- Finding patients with sub-clinical infections
 - Colonization – surveillance cultures
 - Empiric antibiotics – use of confirmed and possible case definitions

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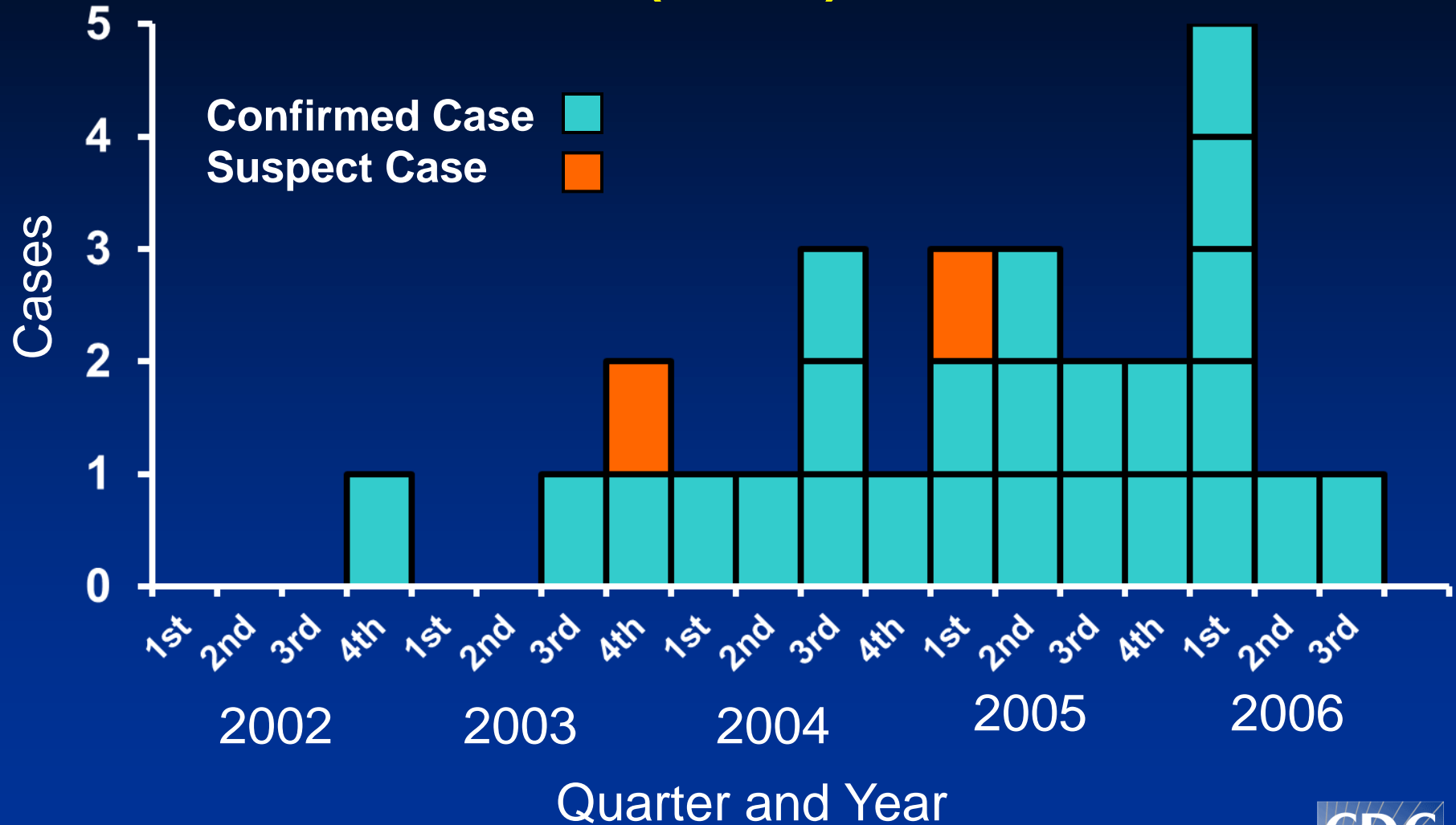
Line listing from investigation of outbreak of gastroenteritis,
Oswego, New York, 1940

ID	AGE	SEX	TIME OF MEAL	ILL	DATE OF ONSET	TIME OF ONSET	Baked ham	Spinach	Mashed potatoes	Cabbage salad	Jello	Rolls	Brown bread	Milk	Coffee	Water	Cakes	Van ice cream	Choc ice cream	Fruit salad
1	11	M	unk	N			N	N	N	N	N	N	N	N	N	N	N	N	Y	N
2	52	F	8:00 PM	Y	4/19	12:30 AM	Y	Y	Y	N	N	Y	N	N	Y	N	N	Y	N	N
3	65	M	6:30 PM	Y	4/19	12:30 AM	Y	Y	Y	Y	N	N	N	N	Y	N	N	Y	Y	N
4	59	F	6:30 PM	Y	4/19	12:30 AM	Y	Y	N	N	N	N	N	N	Y	N	Y	Y	Y	N
5	13	F	unk	N			N	N	N	N	N	N	N	N	N	N	N	N	Y	N
6	63	F	7:30 PM	Y	4/18	10:30 PM	Y	Y	N	Y	Y	N	N	N	N	Y	N	Y	N	N
7	70	M	7:30 PM	Y	4/18	10:30 PM	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y	N	N
8	40	F	7:30 PM	Y	4/19	2:00 AM	N	N	N	N	N	N	N	N	N	N	N	Y	Y	N
9	15	F	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N
10	33	F	7:00 PM	Y	4/18	11:00 PM	Y	Y	Y	N	N	Y	Y	N	N	Y	N	Y	Y	N
11	65	M	unk	N			Y	Y	Y	N	Y	Y	N	N	N	N	N	Y	N	N
12	38	F	unk	N			Y	Y	Y	N	N	Y	N	N	Y	N	N	Y	Y	Y
13	62	F	unk	N			Y	Y	N	Y	Y	Y	Y	N	N	Y	N	N	N	N
14	10	M	7:30 PM	Y	4/19	2:00 AM	N	N	N	N	N	N	N	N	N	N	N	Y	Y	N
15	25	M	unk	N			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
16	32	F	unk	Y	4/19	10:30 AM	Y	Y	N	N	N	Y	N	N	Y	N	Y	Y	Y	N
17	62	F	unk	Y	4/19	12:30 AM	N	N	N	N	N	N	N	N	N	N	N	Y	N	N
18	36	M	unk	Y	4/18	10:15 PM	Y	Y	N	Y	N	Y	Y	N	N	N	N	Y	N	N
19	11	M	unk	N			Y	Y	?	Y	N	Y	N	N	N	Y	N	N	Y	N
20	33	F	unk	Y	4/18	10:00 PM	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	N

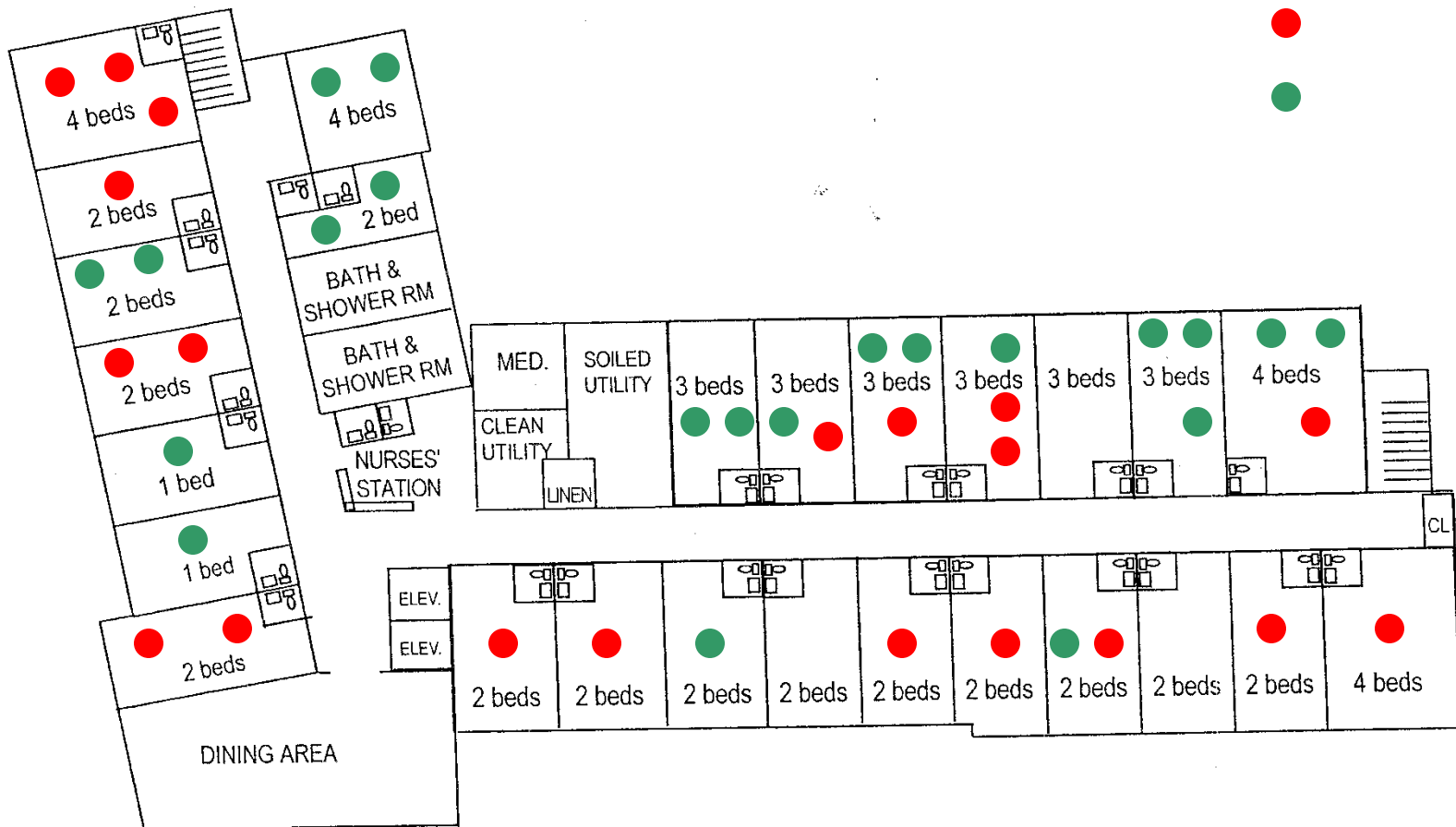
What do You put on Your Line List?

- Important dates (e.g., surgery)
- Admission dates
- Invasive procedures, surgery
- Staff contact
- Outcomes
- Lab results
- Medications
- Locations

NSF Cases in Hospital A by Detection Date, City X 2002-06 (3rd Qtr.) (n=27*)



Spot Map



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Case Reviews

- More in depth chart review
- Looking for things that you might not have captured in your initial line list
- Previous literature might help determine things you should capture

Observations

- Might vary depending on outbreak scenario
- Talk to lots of people
 - What do they think the problem is?
 - How do things they are doing compare to protocols?
- Commonly observed practices
 - Hand hygiene
 - Surgical procedures
 - Use of Contact Precautions
 - Medication preparation
 - Respiratory Therapy
 - Environmental cleaning

Observations: Environmental Services

Pros

- Objective way to evaluate cleaning
- Opportunity to provide feedback
- Relatively simple



Cons

- Not completely standardized
- May not be completely representative
- May be perceived as punitive

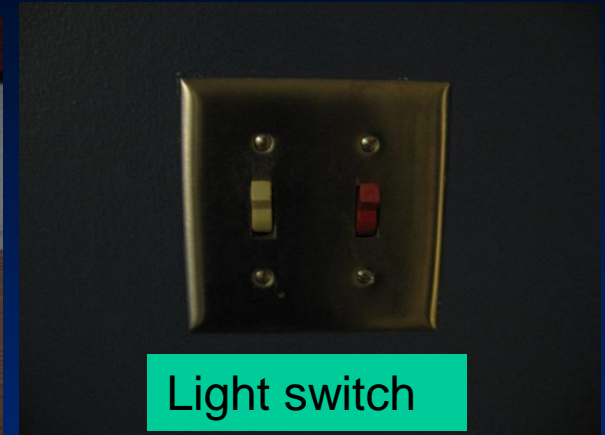
Apply Environmental Marker



Soap dispenser



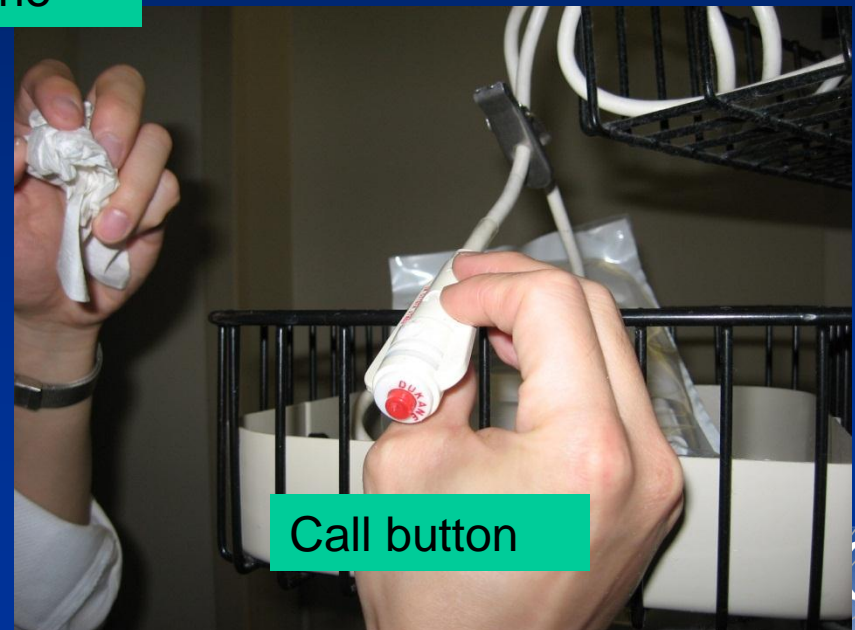
telephone



Light switch

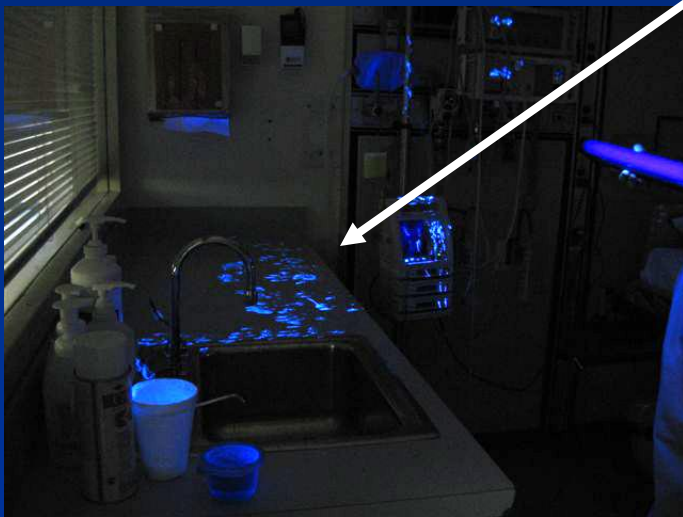
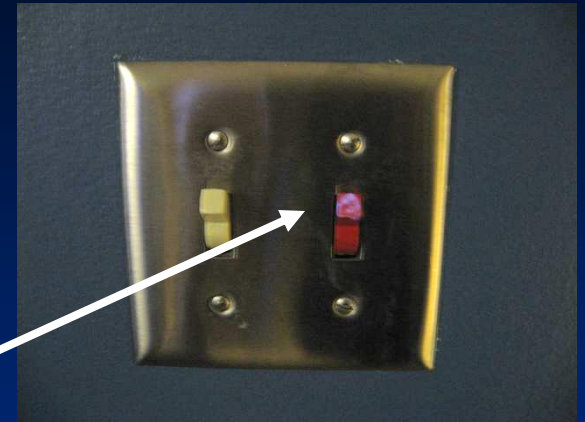
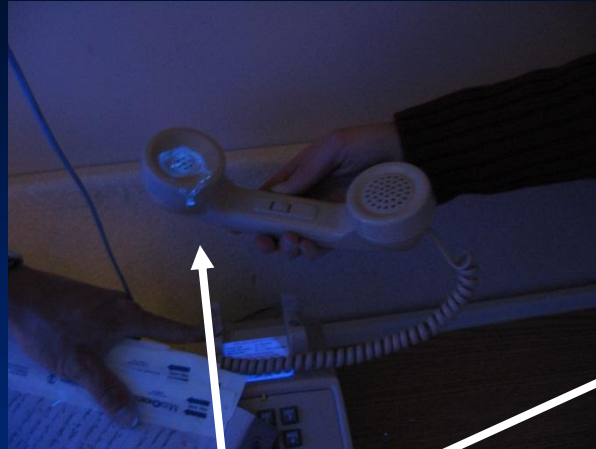


Counter top



Call button

Observe under Black Light



Take a Systematic Approach to Investigation

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Implement Control Activities

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Environmental Sampling

- Often jumped to as an initial step but best to let epidemiology guide sampling
 - Allows for interpretation of results
- Understand limitations
 - Most clinical labs not set up to do this
 - Best to work with labs that are experienced
 - Expensive
- Certain organisms may make environmental sampling more useful

Water Cultures

- Often performed in outbreaks of Gram-negative rods, especially *Pseudomonas* and other rare GNR and non-tuberculous mycobacteria.

Challenges with Water Cultures

- Organisms reside in biofilms and might be released in detectable numbers only intermittently (e.g. during construction).
- Water pathogens have often adapted to live in low nutrient environments
 - Don't grow well on standard media.
- Most tap water has residual chlorine which decreases the yield of cultures.

Surface Sampling

- Surface contamination has been reported as a source in outbreaks of *Acinetobacter*, VRE, *C. difficile*
- Best not done on things like walls and floors
 - Think of mechanisms of transmission

Challenges with Surface Sampling

- Surface contamination is not uniform and widely used methods can only sample a very small surface area.
 - No “standard method”
- Organisms have different survival capacities on surfaces
- Even with the best methods and a known inoculum the yield in getting bacteria off surface is low.
- Yield is further diminished by residual surface disinfectants.

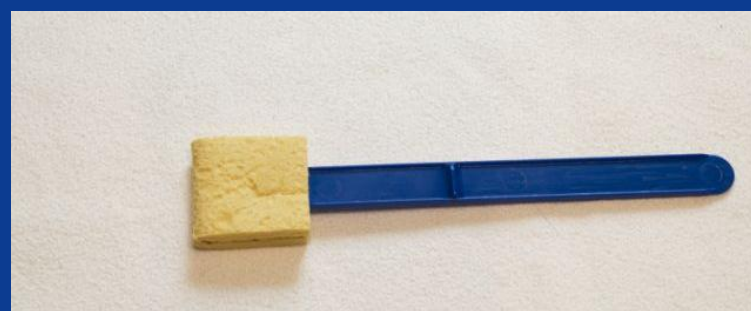
Potential Solutions- Sponge Wipes



Traditional swab



Sponge wipe



Primary advantage of sponge wipes= Increased Surface Area

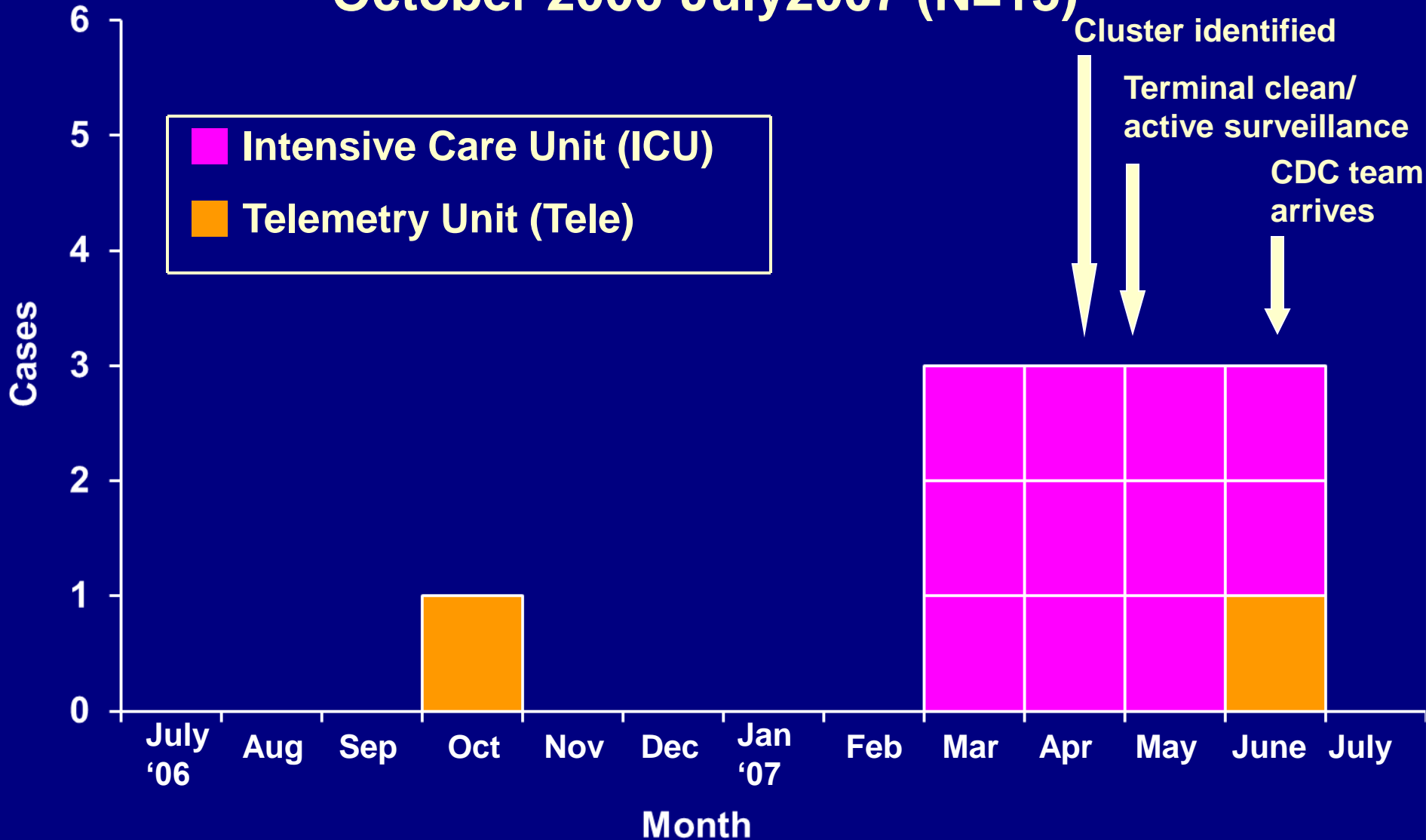
Traditional swab- limited to about 2 square inches per swab

Sponge wipes- can sample up to several square feet

In our investigations, sponge wipes have been positive in several instances when many swabs were negative.

Cases MDR-Ab, Hospital A,

October 2006-July 2007 (N=13)



Laboratory Results

- Case-patient isolates indistinguishable (ST10)
- Outbreak strain (ST10) recovered from two x-ray machines
- All isolates multi-drug resistant



Analytic Study

- Not always necessary
- Time consuming and challenging
- Small number of cases limits power
- Can be useful for supporting your hypothesis if no obvious source identified

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Follow-up

- Follow-up investigation
 - On-going case finding/surveillance
 - Review of control measures
- Communication
 - Keep administrators and stake holders in the loop
 - Let PIO know and have talking points available if expect press attention

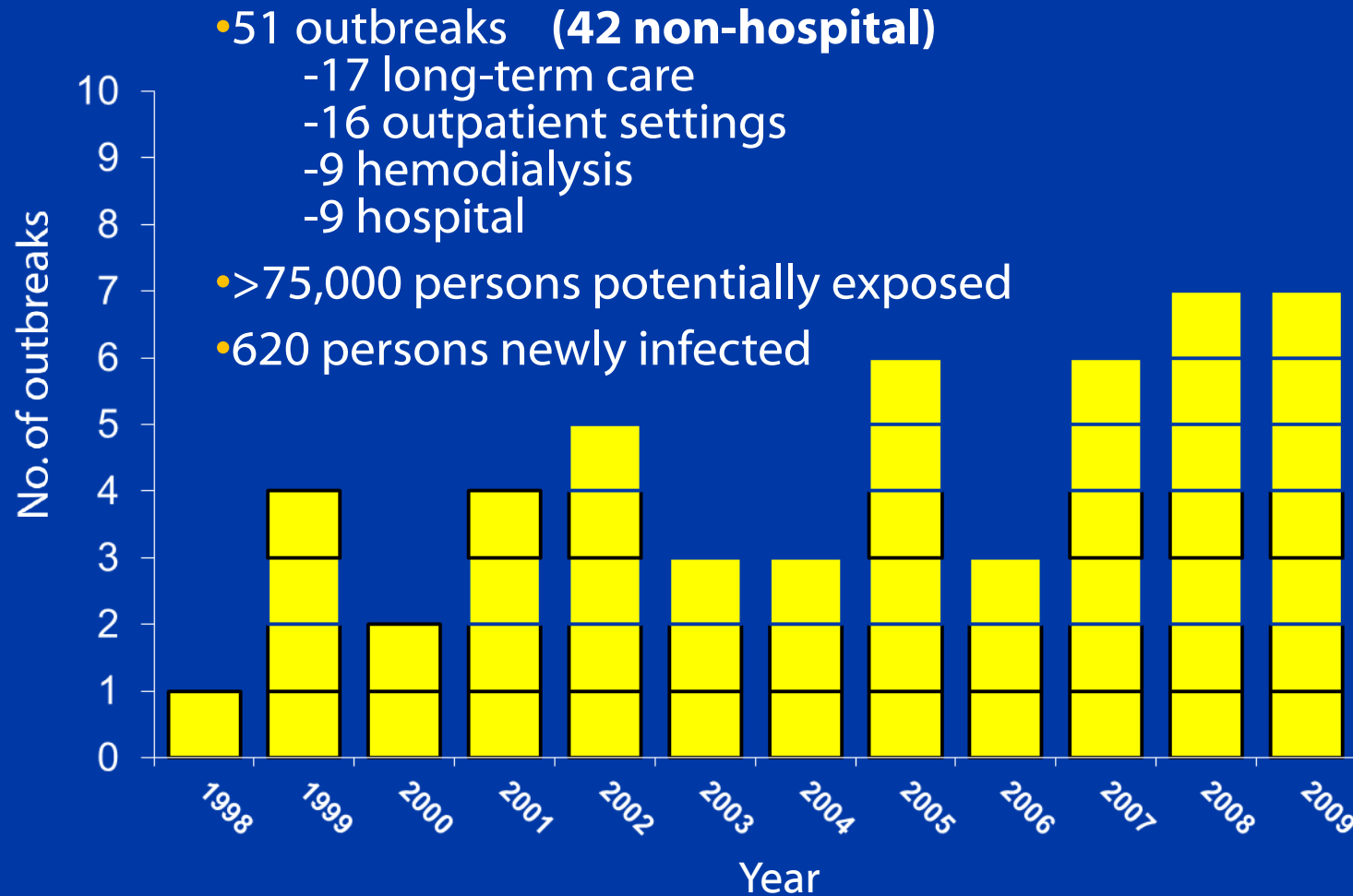
COMMON PROBLEMS AND SCENARIOS

Community as Setting for Outbreak

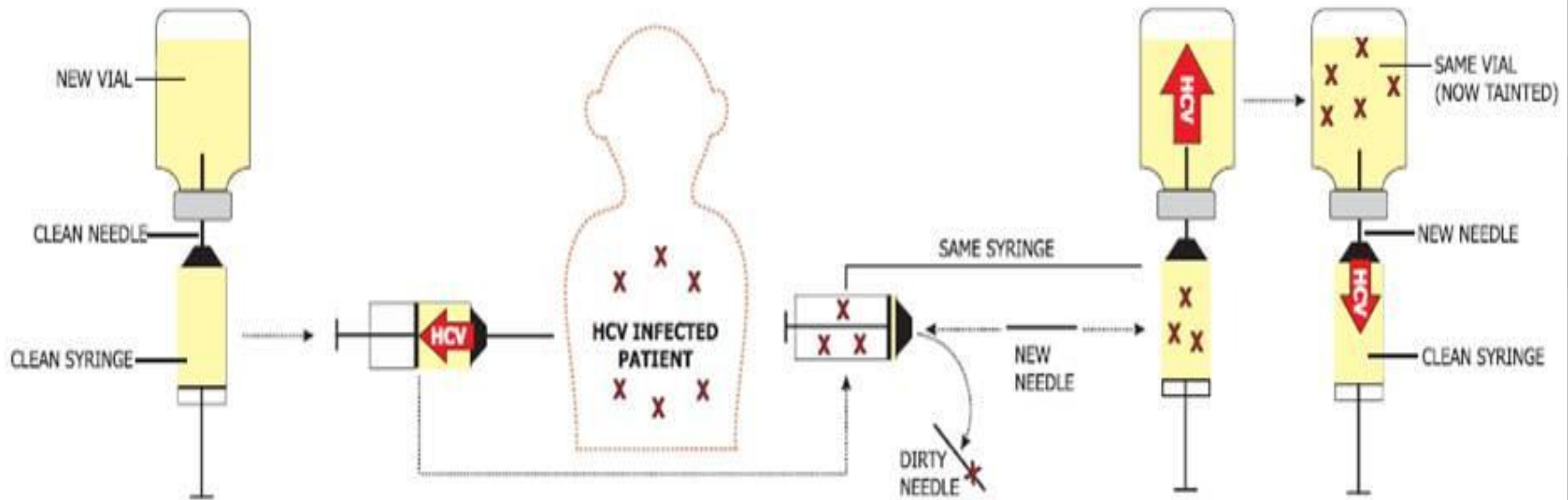
- Many investigations have focused on individual institutions (or units)
- Outbreaks (particularly of new MDROs) can be community-wide
- Coordinated effort might be required across multiple facilities
- Possible role of public health

Injection Safety-related Investigations

Healthcare-associated HBV/HCV outbreaks by year reported – July 1998 to June 2009



The Las Vegas Outbreak: Mechanism



- **Two breaches contributed to transmission:**
 - Re-entering propofol vials with used syringes
 - Using contents from these single-dose vials on more than one patient

Not all Outbreaks are Infectious

- Particularly problematic because there is not a great system to rapidly identify these clusters
 - The “Astute Clinician”
 - Public Health
 - MedWatch

A New Disease – Nephrogenic Systemic Fibrosis

- First identified in late 1990's
- Characterized by thickening and hardening of skin
- Occurs only in dialysis patients
- Variable course
- Unknown cause



Noninfectious Outbreak

- January 7, 2008 DHQP got a call from a hospital epidemiologist about a group of anaphylactic reactions in kids undergoing dialysis...

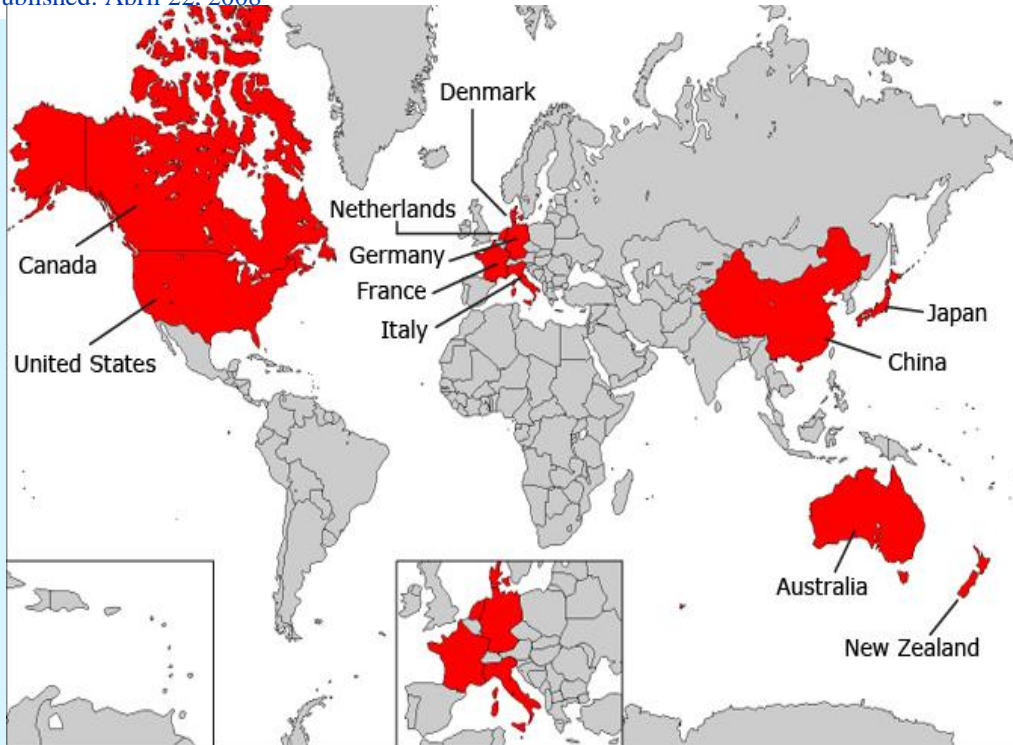
Characteristic	Facilities with cases N=21 Number (%)	Facilities without cases N=23 Number (%)	P-value
Heparin Used			
Baxter*	21 (100%)	1 (4%)	<0.001
Abraxis	2 (10%)	20 (87%)	<0.001
Other*	0(0%)	2 (9%)	0.49
Dialyzer Type			
Gambro	10 (48%)	8 (35%)	0.54
Fresenius	9 (45%)	14 (61%)	0.37
Other	7 (33%)	6 (27%)	0.75
Reuse dialyzers	15 (71%)	9 (39%)	0.04
Prime returned to patient	11 (52%)	13 (59%)	0.76
More than 70 patients	10 (48%)	12 (52%)	1.00

The New York Times

U.S. Identifies Tainted Heparin in 11 Countries

By Gardner Harris

Published: April 22, 2008



<http://www.fda.gov/bbs/topics/news/heparin/heparinmaps.html>

AP Associated Press

FDA Links More Deaths to Blood Thinner

Apr 8, 2008

The Washington Post

Contaminant In Heparin Is Identified

FDA Investigating Manufacturing Process

By Marc Kaufman

Washington Post Staff Writer

Thursday, March 20, 2008

Some Common Associations...

- If narcotics are involved:
 - Think of diversion as a possibility
- If healthcare-associated meningitis:
 - Think of injection safety issues or failure to wear a mask during spinal procedures
- If hepatitis B (or maybe hepatitis C transmission), particularly in long term care/assisted living:
 - Consider blood glucose monitoring as potential source
- If outbreaks of *Acinetobacter*, CDI (or maybe *Enterococcus*):
 - Think about contamination of shared equipment

Thanks for Your Attention. Questions?

For more information please contact Centers for Disease Control and Prevention

1600 Clifton Road NE, Atlanta, GA 30333

Telephone, 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348

E-mail: cdcinfo@cdc.gov Web: www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

**National Center for Emerging and Zoonotic Infectious Diseases
Division of Healthcare Quality Promotion**

